

Chapter Ten

ROADSIDE SAFETY

10-1 ROADSIDE CLEAR ZONES

10-1.01 Definitions

1. Travel Way. The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.
2. Roadside Clear Zones. The distance beyond the edge of travel lane that should be clear of any non-traversable hazards or fixed objects.
3. Non-Traversable Hazards. A general term to describe roadside features which cannot be safely traversed by a run-off-the-road vehicle.
4. Parallel Slopes. Cut and fill slopes for which the toe runs approximately parallel to the flow of traffic.
5. Transverse Slopes. Cut and fill slopes for which the toe runs approximately perpendicular to the flow of traffic. Transverse slopes are typically formed by intersections between the mainline and driveways, median crossovers or side roads.
6. Recoverable Parallel Slope. Slopes which can be safely traversed and upon which an errant motorist has a reasonable opportunity to stop and return to the roadway. Fill slopes 4:1 and flatter are considered recoverable.
7. Non-Recoverable Parallel Slope. Slopes which can be safely traversed but upon which an errant motorist is unlikely to recover. The run-off-the-road vehicle will likely continue down the slope and reach its toe. If a fill slope is 3:1 or flatter and also steeper than 4:1, this is considered a non-recoverable parallel slope.
8. Critical Parallel Slope. Slopes which cannot be safely traversed by a run-off-the-road vehicle. Depending on the encroachment conditions, a vehicle on a critical slope may

overturn. Fill slopes steeper than 3:1 are considered critical. A roadside barrier is warranted on a critical parallel slope.

10-1.02 General Application

The clear zone widths presented in this *Guide* must be placed in proper perspective. The distances imply a degree of accuracy that does not exist. They do, however, provide a good frame of reference for making decisions on providing a safe roadside area. Each application of the clear zone distance must be evaluated individually, and the designer must exercise good judgment. In general, the designer should provide as much clear zone as can be obtained practically.

When using the recommended clear zone distances, the designer should consider the following:

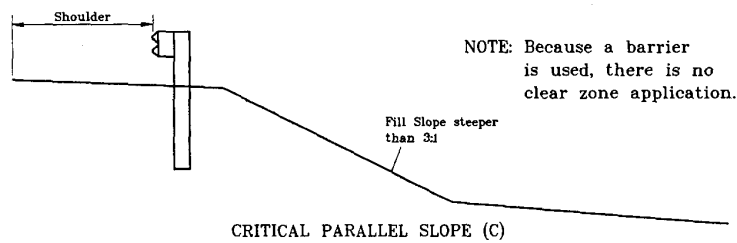
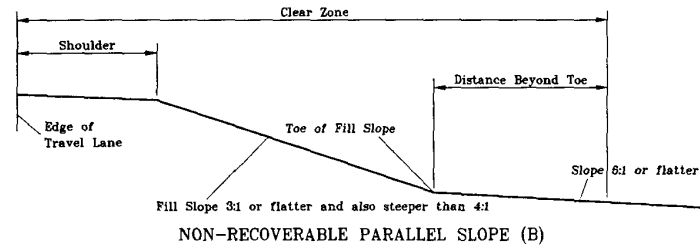
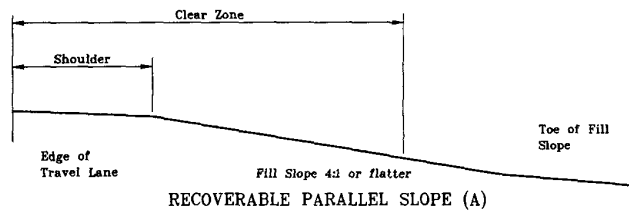
1. Project Scope of Work. The clear zone distances in Section 10-1 apply to all freeway projects and to new construction/reconstruction projects on non-freeways. Chapter Eleven presents the criteria for 3R projects on non-freeways.
2. Context. If a formidable obstacle lies just beyond the zone, it may be appropriate to remove or shield the obstacle if costs are reasonable. Conversely, the clear zone should not be achieved at all costs. Limited right-of-way or unacceptable construction costs may lead to installation of a barrier or perhaps no protection at all.
3. Boundaries. The designer should not use the clear zone distances as boundaries for introducing roadside hazards such as bridge piers, non-breakaway sign supports, utility poles or landscaping features. These should be placed as far from the roadway as practical.
4. Roadside Cross Section. The recommended clear zone distance will be based on the type of roadside cross section. Figure 10-1 presents a schematic for the various possibilities.
5. Highway Design Adjustments. The recommended clear zone distance should be adjusted for the highway design speed and traffic volumes, as indicated in Table 10-1. See Section 10-1.05 for adjustments on horizontal curves.
6. Traffic Distribution (Multi-Lane Highways). Table 10-1 presents traffic volume distribution by lane for both 4-lane and 6-lane facilities. Although no specific adjustments are presented for clear zone values, these lane distributions should be considered. For example, all other factors being equal, Table 10-1 indicates that the clear zone on the right side of a 4-lane divided facility should be more than that on the median side.

4-Lane Roadway		
AADT	Median Lane (%)	Right Lane (%)
12,000	20	80
24,000	25	75
36,000	33	67
48,000	41	59
60,000	50	50

6-Lane Roadway			
AADT	Median Lane (%)	Center Lane (%)	Right Lane (%)
24,000	22	47	31
48,000	31	43	26
72,000	35	40	25
96,000	37	38	25
120,000	37	37	26

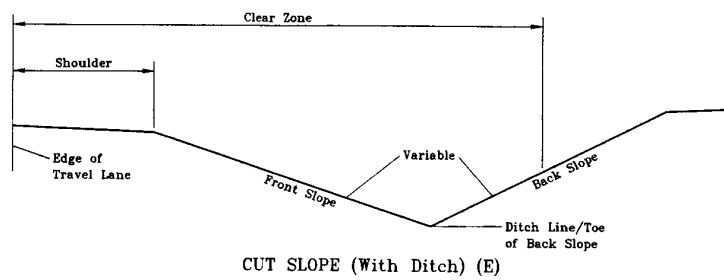
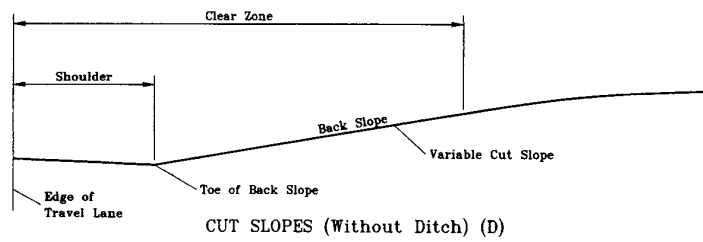
**LANE DISTRIBUTION OF TRAFFIC VOLUMES
(Multi-Lane Highways)**

Table 10-1



ROADSIDE CROSS SECTION SCHEMATICS
(Clear Zone Application)

Figure 10-1



ROADSIDE CROSS SECTION SCHEMATICS
(Clear Zone Application)
(Continued)

Figure 10-1

10-1.03 Parallel Slopes

Table 10-2 presents the Department's criteria for clear zones on cut and fill slopes which run parallel to the highway. The following discusses the application of the table:

1. Recoverable Fill Slopes. For parallel fill slopes 4:1 and flatter (Figure 10-1(A)), the recommended clear zone distance can be determined directly from Table 10-2.
2. Non-Recoverable Fill Slopes. For parallel fill slopes steeper than 4:1 but 3:1 or flatter (Figure 10-1(B)), the recommended clear zone includes a distance beyond the toe of the slope. Use the following procedure to determine the clear zone:
 - a. The slope beyond the toe of the non-recoverable fill slope will probably be 6:1 or flatter. Determine the clear zone distance for a 6:1 or flatter slope from Table 10-1 for the applicable design speed and traffic volume.
 - b. To determine the recommended distance beyond the toe, subtract the shoulder width from the distance in "2a."
 - c. On new construction/reconstruction projects, if the distance in "2b" is greater than 10 feet, this distance will be the desirable clear zone distance beyond the toe; 10 feet will be the minimum. If the distance in "2b" is less than 10 feet, the minimum clear distance will be 10 feet beyond the toe.
3. Cut Slopes (Without Ditch). For roadside cross sections which match Figure 10-1(D), use the clear zone criteria in Table 10-2 for fill slopes 6:1 or flatter.

The following examples illustrate how to determine the clear zone distance for various parallel slopes.

* * * * *

Example 1 (Recoverable Fill Slope)

Given: Project Scope of Work -- Reconstruction
 Fill Slope -- 4:1
 Design Speed -- 60 mph
 Design AADT -- 7000

NEW CONSTRUCTION/RECONSTRUCTION PROJECTS

Design Speed (mph)	Design AADT **	Fill Slopes			Cut Section With Ditch (Figure 10-1(E))
		Recoverable (Figure 10-1(A))		Non-recoverable (Figure 10-1(B))	
		6:1 or Flatter	5:1 to 4:1		
40 or Less	Under 750	7 - 10	7 - 10	SEE PROCEDURE IN SECTION 10-1.03.	SEE PROCEDURE IN SECTION 10-1.04.
	750 - 1500	10 - 12	12 - 14		
	1500 - 6000	12 - 14	14 - 16		
	Over 6000	14 - 16	16 - 18		
45-50	Under 750	10 - 12	12 - 14		
	750 - 1500	14 - 16	16 - 20		
	1500 - 6000	16 - 18	20 - 26		
	Over 6000	20 - 22	24 - 28		
55	Under 750	12 - 14	14 - 18		
	750 - 1500	16 - 18	20 - 24		
	1500 - 6000	20 - 22	24 - 30		
	Over 6000	22 - 24	26 - 32*		
60	Under 750	16 - 18	20 - 24		
	750 - 1500	20 - 24	26 - 32*		
	1500 - 6000	26 - 30	32 - 40*		
	Over 6000	30 - 32*	36 - 44*		
65-70	Under 750	18 - 20	20 - 26		
	750 - 1500	24 - 26	28 - 36*		
	1500 - 6000	28 - 32*	34 - 42*		
	Over 6000	30 - 34*	38 - 46*		

* On non-freeways, the clear zone distance may be limited to 30' for practicality and to provide a consistent roadway template.

** Use the AADT projected for the design year for the overall project.

RECOMMENDED CLEAR ZONE DISTANCES
(In Feet Measured From Edge of Travel Lane)

Table 10-2

Problem: Determine the recommended clear zone distance.

Solution: From Table 10-2, the clear zone distance should be 36' - 44'. Note that this distance will apply regardless of the shoulder width. However, as indicated in a footnote to the table, the clear zone distance may be limited to 30' based on specific site conditions to provide a more practical design.

Example 2 (Non-Recoverable Fill Slope)

Given: Project Scope of Work -- Reconstruction
Fill Slope -- 3:1
Design Speed -- 60 mph
Design AADT -- 2000
Shoulder Width -- 6'

Problem: Determine the recommended clear zone distance.

Solution: The procedure in Section 10-1.03 for non-recoverable fill slopes is used as follows:

- a. From Table 10-2, the clear zone for a flat side slope is 26' - 30'.
- b. The recommended clear distance beyond the toe of the fill slope is 20' - 24' (the distance in "a" minus the shoulder width).
- c. For a reconstruction project, the desirable clear distance beyond the toe of slope is 20' - 24'; the minimum distance is 10'.

* * * * *

10-1.04 Cut Slopes (With Ditches)

Ditch sections, as illustrated in Figure 10-1(E), are frequently constructed in roadside cuts. The applicable clear zone across a ditch section will depend upon the front slope, the back slope, the horizontal location of the toe of the back slope, and various highway factors. The designer will use the following procedure to determine the recommended clear zone distance:

1. Check Front Slope. Use Table 10-2 to determine the clear zone based on the ditch front slope.

- ditch*
2. Check Location of the Toe of Back Slope. Based on the distance from Step #1, determine if the toe of the back slope is within the clear zone. If the toe is at or beyond the clear zone, then the designer usually need only consider roadside hazards within the clear zone on the front slope. If the toe is within the clear zone, the designer should evaluate the practicality of relocating the toe of back slope. This may be accomplished by, for example, providing a flat bottom ditch or by deepening the ditch line. If the toe of back slope will remain within the clear zone, #3 below will apply.
 3. Check for Roadside Hazards. If the toe of the back slope is within the clear zone distance from #1 above, a clear zone should be provided on the back slope. This clear zone will be a distance beyond the toe of back slope as follows:
 - a. Back Slope 3:1 or Steeper ($V > 50$ mph). The distance will be 10 feet beyond the toe or to a distance from #1 above beyond the edge of travel lane, whichever is less.
 - b. Back Slope 3:1 or Steeper ($V \leq 50$ mph). The distance will be 5 feet beyond the toe or to a distance from #1 above beyond the edge of travel lane, whichever is less.
 - c. Back Slope Flatter than 3:1. Use the distance from #1 above measured from the edge of travel lane.

* * * * *

Example 3 (Clear Zones at Ditch Sections)

Given: Front Slope -- 4:1
 Ditch Bottom Width -- 0' (V-ditch)
 Back Slope -- 2:1
 Design Speed -- 60 mph
 Design AADT -- 4000

Problem: Determine clear zone implications for these conditions.

Solution: Using the procedure in Section 10-1.04, the following applies:

1. Check Front Slope. According to Table 10-2, the clear zone distance for the front slope is 32' - 40', with a practical limit of 30' acceptable.
2. Check Location of Ditch Line. Desirably, the toe of the back slope will be at or beyond 30'. If this is not practical, #3 below will apply.

3. Check for Roadside Hazards. For a 2:1 back slope (assuming it is retained) and a design speed of 60 mph, the clear zone distance will be to 10 feet beyond the toe of back slope or to 30 feet from the edge of travel lane, whichever is less.

* * * * *

10-1.05 Horizontal Curves

On the outside of horizontal curves, run-off-the-road vehicles may travel a farther distance from the travel lane before regaining control of the vehicle. The designer may choose to modify the clear zone distance obtained from Table 10-2 for horizontal curvature. These modifications are normally only considered where accident history indicates a need, or a specific site investigation shows a definitive accident potential which could be significantly lessened by increasing the clear zone width and such increases are cost effective.

Where adjustments will be applied, Table 10-3 provides recommended factors for clear zones on horizontal curves. A diagram illustrates the application on a curve.

10-1.06 Curbed Sections

On urban streets where curbs are provided, the minimum clear zone distance is 1.5 feet from the gutter line. Where both a barrier curb and sidewalk are present, the minimum clear zone distance is 1.0 feet from the face of curb. However, if practical, a 3-foot clear zone distance should be provided, especially at intersections and driveway entrances.

10-1.07 Examples of Roadside Hazards

Clear zones should be free of all roadside hazards. These include, but are not limited to, the following:

1. bridge piers and abutments,
2. boulders,
3. culvert headwalls,
4. retaining walls,
5. non-breakaway sign and luminaire supports,
6. trees,

K_{CZ} CURVE CORRECTION FACTOR

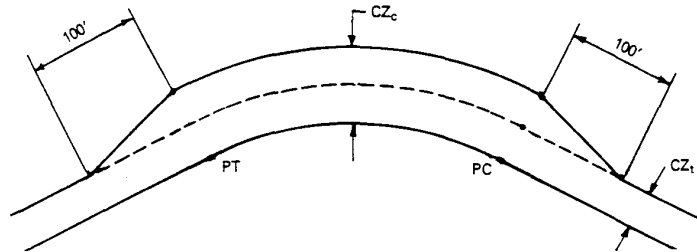
DEGREE OF CURVE	DESIGN SPEED						
	40	45	50	55	60	65	70
2.0	1.08	1.10	1.12	1.15	1.19	1.22	1.27
2.5	1.10	1.12	1.15	1.19	1.23	1.28	1.33
3.0	1.11	1.15	1.18	1.23	1.28	1.33	1.40
3.5	1.13	1.17	1.22	1.26	1.32	1.39	1.46
4.0	1.15	1.19	1.25	1.30	1.37	1.44	
4.5	1.17	1.22	1.28	1.34	1.41	1.49	
5.0	1.19	1.24	1.31	1.37	1.46		
6.0	1.23	1.29	1.36	1.45	1.54		
7.0	1.26	1.34	1.42	1.52			
8.0	1.30	1.38	1.48				
9.0	1.34	1.43	1.53				
10.0	1.37	1.47					
15.0	1.54						

$$CZ_c = (CK_T)(K_{CZ})$$

Where: CZ_c = clear zone on outside of curve, ft

CZ_T = clear zone on tangent section, ft

K_{CZ} = curve correction factor



HORIZONTAL CURVE ADJUSTMENTS

Table 10-3

7. utility poles, and
8. permanent bodies of water.

For roadside features within the clear zone, a determination that the feature is a hazard will be made on a case-by-case, project-by-project basis.